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NEW DATA ON GEORGIA TEKTITES

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Abstract

Geologic field work in Dodge County, Georgia, has demonstrated that all of the Georgia tektites have been found on a sand and gravel stratigraphic unit of probable Pliocene or Pleistocene age that unconformably overlies older Tertiary rocks. Because of the older potassium-argon ages of the tektites, it is probable that the tektites have been reworked and transported from some older stratigraphic unit to the north or northwest. It is recommended that the term "strewnfield" be abandoned in reference to the Georgia tektite occurrence. The results of a chemical analysis of a new specimen (DGA-1) are similar to those of the only previous analysis of a Georgia tektite (USNM 1396) reported by Clarke and Carron (1961).

AUTHOR

Previous Work

The first tektites from Georgia were identified by Dr. E. P. Henderson of the Smithsonian Institution in 1938. Stair (1955a, 1955b, 1956) published the absorption spectrum of a Georgia tektite, a photomicrograph of the same piece, and a photograph of another specimen from Georgia. Barnes and Bruce (1959) visited the area, examined several specimens, and confirmed the Georgia tektite occurrence. Bruce (1959) published photographs of several specimens from Georgia as well as a discussion of the finds.

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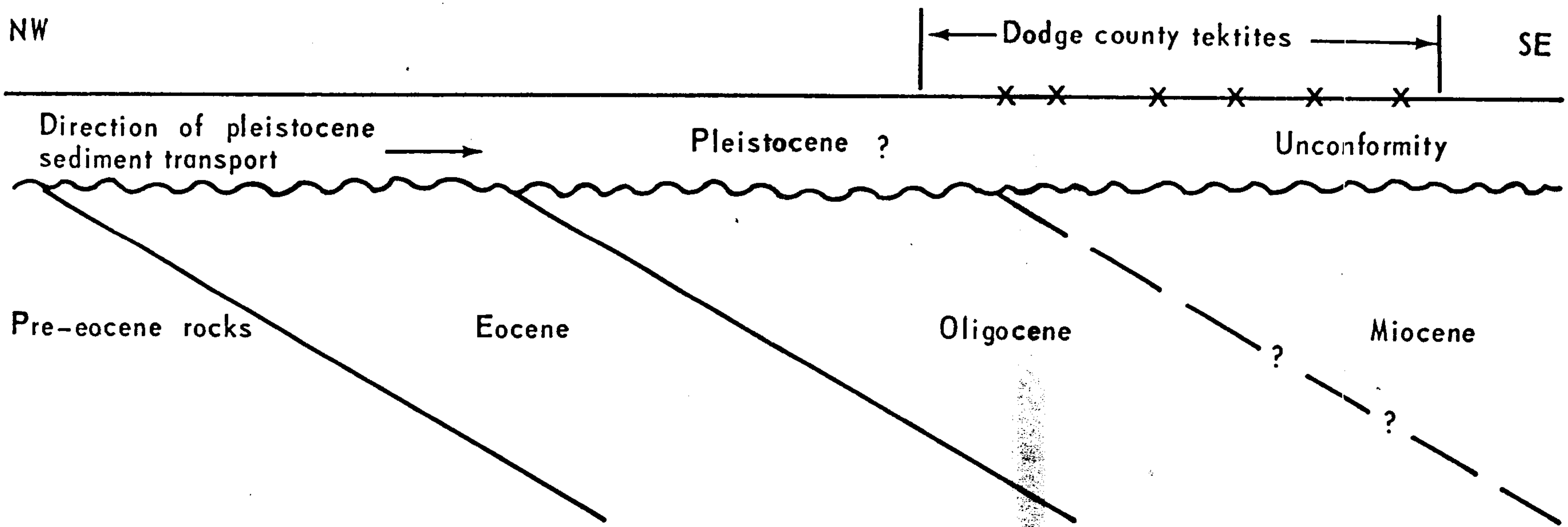

Figure 1. Schematic cross-section of a portion of the Georgia Coastal Plain

Cohen (1959) compared the Georgia tektites to the moldavites and bediasites and presented spectrochemical data and physical properties. Senftle and Thorpe (1959) presented data on the magnetic susceptibility and magnetization of a Georgia tektite. Reynolds (1960), Gentner and Zähringer (1960), Zähringer (1961), and Zähringer (1963) measured the potassium-argon ages of tektites from numerous localities. The most recent data indicate that the Georgia tektites are about 34 million years old. Clarke and Carron (1961) published a comprehensive physical and analytical study of a Georgia tektite (USNM 1396), including the only chemical analysis available until now. Clarke and Carron also discussed the possibility that the Georgia tektites might be artificial glass, and compared the Georgia tektites with the single specimen from Martha's Vineyard, Massachusetts. Clarke and Henderson (1961) published photographs of several Georgia tektites, discussed the problems of their field occurrence, and summarized most of the previous information. Furcron (1961) discussed the geologic age of the Georgia tektite shower and concluded that there was sufficient evidence to suggest a Pliocene-Pleistocene age for the fall. Pinson and Schnetzler (1962) analyzed a fragment of a Georgia tektite for strontium and rubidium. King (1962) reported finds of three new Georgia tektites and published photographs and brief descriptions of the specimens. King also discussed the stratigraphy of the Georgia tektite occurrence and concluded that the stratigraphic evidence was insufficient to date the fall. Taylor (1963) analyzed a fragment of a Georgia tektite (DGA-1) for oxygen isotopic composition.

Stratigraphy

During late summer of 1962, the geology of Dodge County was mapped in the field at the scale of 4 inches per mile on aerial photographs furnished by the Georgia Geological Survey. No stratigrapher has previously worked specifically with Dodge County, although Dodge County was included in larger reconnaisance mapping projects and regional studies. Furcron (1961) summarized the previous stratigraphic work.

Dodge County contains two mappable stratigraphic units in the areas of the tektite occurrences. The upper unit, upon which all of the Georgia tektites have been found, is sand, clayey sand, and gravel. The upper unit unconformably overlies a lower unit composed of clay and sandy clay. These relationships hold true wherever these units are found throughout Dodge County. The same upper unit unconformably overlies Oligocene rocks in Pulaski County, Georgia, and marine Eocene rocks in Twiggs County. The lower unit is unfossiliferous at the surface, but is reported to grade into limestone containing Middle Miocene foraminifera in the down-dip subsurface. The age of the lower unit is thus believed to be Miocene. The first fossils found in well cuttings from Dodge County are Middle Oligocene foraminifera that occur at 100 to 150 feet below the surface. The upper unit is also unfossiliferous. The upper unit is believed to be Pleistocene because of its unconformable relationship to older rocks, coarse grain size, non-marine environment of deposition, and general similarity to units of known Pleistocene age that are found elsewhere on the Gulf Coastal Plain. The occurrence of 34 million year old tektites on Pleistocene rocks does not present any problem. It is probable that the tektites have been eroded from older Early Oligocene or Late Eocene rocks to the north or northwest and were transported 10 to 15 miles to their present localities in Dodge County along with the Pleistocene sand and gravel. There are no tektite-surface morphological criteria by which transport of the tektites over such a short distance can be established or disproven. The transportation of the tektites from older stratigraphic units is clearly possible (fig. 1), and the potassium-argon age of the tektites indicates that this has occurred. If tektites originated outside of the earth-moon system, they should contain measurable amounts of cosmic-ray-induced radioactivity; but this activity has not been found in any group of tektites. If the tektites did originate within the earth-moon system, they should be about the same age as the sedimentary rocks into which they fall. The only stratigraphic way to demonstrate conclusively that the reworking of the tektites from older units has occurred is to find a tektite in situ in one of the older stratigraphic units. Because of the rarity of specimens and the small number of good exposures of older units, such a tektite is not likely to be found. The find of a tektite in situ in the upper sand and gravel unit would not prove the age of the fall. The tektites are probably weathering out of the sand and gravel unit upon which they are found.

Analytical Data

King (1962) reported that three new specimens were found during field work, and another tektite was obtained from a local resident. Plaster casts of these four specimens were given to the permanent collections of the Georgia Geological Survey. A fragment of one of the specimens (DGA-1) was analyzed and the results of the analysis are presented in table I.

TABLE I

Chemical Analysis of Georgia Tektite DGA-1.[a]

SiO_2	81.84 wt. %
Al_2O_3	10.40
Fe_2O_3	none
FeO	2.30
CaO	0.58
MgO	.67
MnO	0.03
Na_2O	0.97
K_2O	2.15
H_2O+	0.32
H_2O-	0.22
TiO_2	0.41
P_2O_5	trace
total	99.89

Spectrographically detected elements:

Ba, V, Zr - 0.00X %

Cu, Sr, Y, Yb - trace.

(a) Analyst, Jun Ito; weight of analyzed fragment, 4.442 grams; weight of complete specimen, 25.945 grams; analysis reported, December 29, 1962.

This analysis is very similar to the analysis of USNM 1396 reported by Clarke and Carron (1961) with slight exceptions. No ferric iron was detected in the original analysis of DGA-1. Ito confirmed this analysis by using an additional fragment weighing 0.75 gram from the same specimen. Ferric iron content was determined by direct titration with titanous chloride solution in sulfuric acid after dissolution of the specimen in hydrofluoric and sulfuric acids in which methylene blue was used as the endpoint indicator. A trace of ferric iron was detected by this method; however, it is very doubtful that this trace was present in the tektite in this oxidation state. These wet chemical methods are liable to oxidation errors during the procedures of sample preparation, dissolution, and transfer of the solution into another vessel for titration. The "essential" water value is greater than those values reported for most tektites, and may be in error. The silica content, which is 1.3 percent greater than USNM 1396, makes this the most siliceous North American tektite yet analyzed.

On the basis of the only two analyses now available as well as previously reported physical properties, it appears that the Georgia tektites may have a much more restricted range of composition than the bediasites. However, it is unlikely that the small number of specimens (approximately 24) is representative of the total variation within the group.

An absorption spectrum [2] of a slice of DGA-1 is virtually identical to that of USNM 1396 presented by Clarke and Carron (1961), when corrected for specimen thickness.

Taylor (1963) analyzed a fragment of DGA-1 for oxygen isotopic composition, and obtained a value of $\delta\ O^{18}/O^{16} = +9.8$ o/oo. The value was obtained by the fluorine extraction method and reported relative to the sea water standard.

Several types of artificial glass found with surface gravels in Dodge County were examined by microscopy and by X-ray fluorescence analysis. None of these glasses are similar to the Georgia tektites in composition, inclusions, or morphology. There is no reason to suspect an artificial origin of the tektites, especially in view of their 34 million year old potassium-argon ages.

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(2) Spectrum obtained by Dr. Carl Pitha, Crystal Growth Section, Air Force Cambridge Research Laboratories.

There is no evidence of two periods of melting on the 15 specimens that the writer has examined, although several of the tektites have their primary shapes well preserved.

Conclusions

The Georgia tektites are found on rocks that are too young to be concordant with their older potassium-argon age. Because it is probable that the tektites have been reworked and transported from one of the older stratigraphic units to the north or northwest, it is recommended that the term "strewnfield" (implying that the tektites have fallen where they are now found) be abandoned in reference to the Georgia tektites.

None of the man-made glasses examined from Dodge County are similar to the Georgia tektites.

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